Los Angeles Trade Tech. Jr. College
Instructor: R.H. Oeffinger

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May 13 1957

# ELECTRONICS TECHNICIAN

## ASSIGNMENT

## Modulation--AM

Answer the following questions with not less than three or more than ten sentences:

1. What is the difference between high-level and low level modulation? Explain advantages and disadvantages of both.

2. Repeat above with grid and plate modulation.

3. Draw schematic of two types of plate modulation and explain their operation.

4. For 100% modulation and plate modulation how much audio power must be furnished?

5. Give the formula for determining % of modulation and include an example.

6. How are the side bands produced and what importance do the have with respect to the information being transmitted?

7. If palte supply voltage is 800 volts what will the voltage ( peak ) be across the tank capacitor with 100% modulation?

8. What is the difference c-w and m-c-w?

9. In a modulated signal what determines the amplitude and frequency of the information?

10. Explain the relation between bandwidth and frequency of the information.

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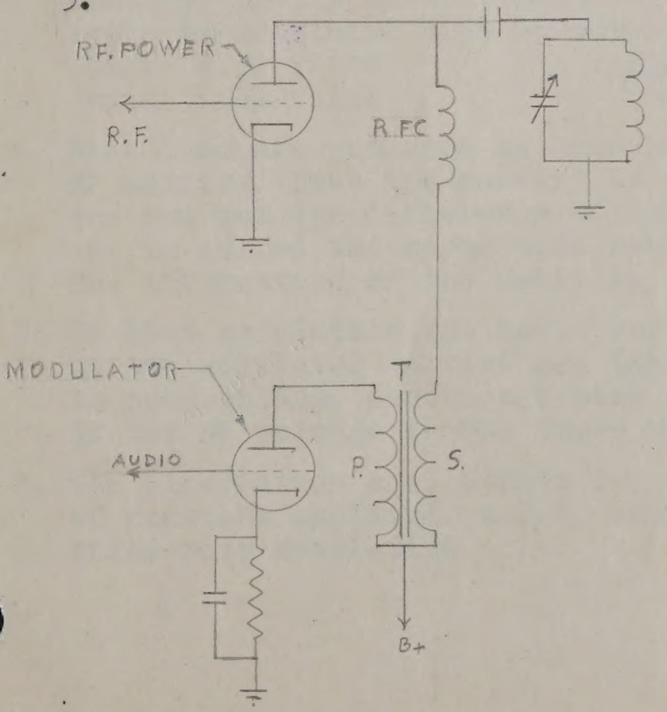
## TECHNICAL REPORT

Title: Assignment: AM Modulation

1. High-Level modulation is modulation of an RF carrier produced in the plate of the last stage of the transmitter.
   Low-Level modulation is modulation produced in an earlier stage than the final. A disadvantage of Low-Level modulation is that the intermidiate stages must be operated as linear amplifiers, with enough bandwidth for the side bands, therefore this method is not too efficient. On the other hand, with High-Level modulation all the stages may be operated class C for more power and efficiency, although more audio power is needed.

2. Grid Modulation means that the audio power is injected in the control grid of the stage, which in effect varies the bias of the tube, varying the plate voltage at the audio rate.
   Plate Modulation is obtain by impressing the audio power upon the carrier on the plate circuit of the RF stage. Wit grid modulation the stage must be operated CLASS A to avoid excesive distortion, the plate efficiency is low and it is difficult to achieve a large degree of modulation. The advantage is that the amount of audio power is not too great. Plate modulation accomplishes a minimum of distortion with a maximum efficiency, but more audio power is needed.

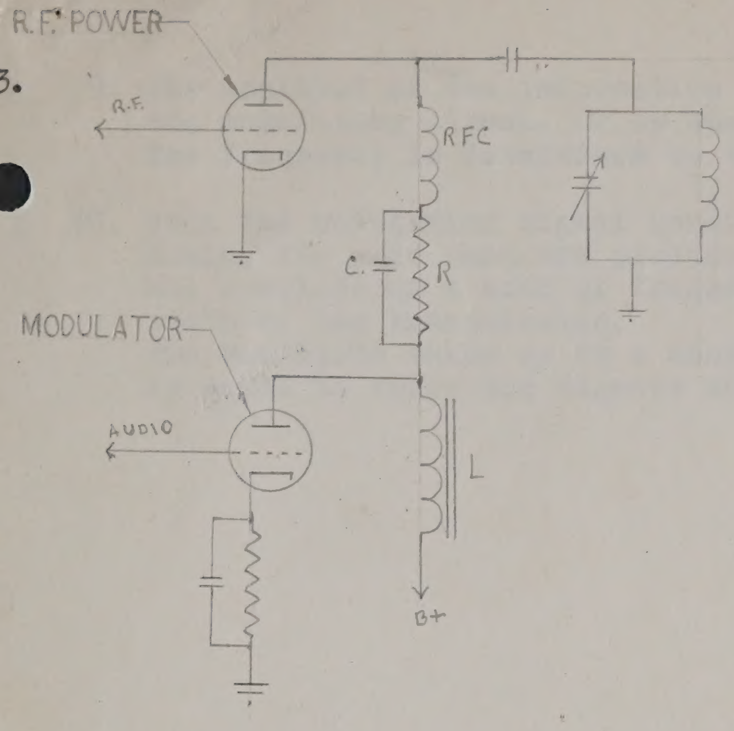
3.



Transformer coupled plate modulator circuit

The audio otput of the modulator is coupled through transformer T to the plate circuit of the power ampl. The voltage across the secondary will vary at the audio frequency, adding and subtracting to the plate voltage of the RF power ampl. thereby modulating The RF output of the stage.
The RFC prevents the RF from going to the power supply.
The amount of modulation will depend on the relative amounts of the audio and DC voltages.

3.



## Heising or constant current modulator

Modulation here is obtain by the action of choke L. As the plate current of the modulator changes, a voltage will be developed across the choke.
When the plate current of the modulator increases the expanding magnetic field of the choke induces a voltage which will tend to oppose the change of current. This voltage will buck the voltage applied to the plate of the RF amplifier, thereby reducing it's plate current. When the modulator plate current decreases the field collapses, inducing a voltage which aids the voltage in the plate of the RF stage and increases it's plate current. Thus there will be a changing voltage and current in the RF stage in accordance with the audio signal. As the current in the modulator is increasing the current in the RF stage is decraesing and vice-versa, keeping the current from the power supply constant; therefore the name: Constant current.
The purpose of the resistor R is for 100% modulation, obtained by operating the RF stage at lower plate potential than the modulator.

4. When using plate modulation at 100% modulation, the value of the audio power must equal $\frac{1}{2}$ of the RF carrier power. This is because with 100% modulation, the amplitud of each side band is $\frac{1}{4}$ the amplitud of the carrier.

5. Formula for % modulation: $\frac{E_{max} - E_{min.}}{E_{max} + E_{min}} \times 100$
Where: Emax. = The peak value of the modulated RF voltage.
And: Emin. = The minimum peak value of the modulated RF voltage.
Example: What % modulation will be obtain when an RF carrier of 100 peak volts is modulated with an audio signal of 50 volts peak?
Emax. = 150 volts
Emin. = 50 volts $\therefore$ $\frac{150 - 50}{150 + 50} \times 100 = 50\%$ modulation.

6. Side bands are produced by heterodyne action of the modulating signal and the RF carrier. When the carrier is modulated, there will be two more frequencies The sum and the difference of the carrier fr. and the modulating fr. The sum is called the upper side band and the difference is the lower side band. The imformation of the audio is carried in the side bands.

7. In 100% modulation the audio voltage is equal to the RF voltage. The peaks of the modulated carrier are the sum of these voltages. Therefore the peak to peak voltage across the tank capacitor will be 4 times the RF voltage. If the RF voltage is 800 there will be 3200 volts across the capacitor.

8. The abreviation c.w. stands for continous wave. This means an RF carrier of constant amplitud. M.C.W. means a modulated continous wave or an RF carrier with modulation.

9. The amplitud of the imformation will be determined by the strengh of the modulating signal. Or by the % of modulation.
The frequency is determined by the frequency of the modulating signal.

10. When the modulating signal consists of multiple frequencies, as with music, two side bands are produced by each frequency. The radiated signal consists of a band of frequencies. This band is called the banwidth of the transmission.
The bandwidth taken up by a conventional double-side band AM signal is equal to twice the highest modulating frequecy.